

IERS 1996 Workshop

Report on Topic 2 : Reference Frames [Preliminary 9/11/96]

Introduction

*** This report is to introduce key issues and to initiate discussions

*** The amount of IERS involvement is one of the key issues

*** The conclusions of this workshop should incorporate the decisions of the WGRF

*** The IERS must respect the areas covered by other specialists.

1) Maintenance of the ICRF

*** no rotation criterion : ?

It is considered that the maintenance of the ICRF must be one of the three major objectives of IERS, together with the maintenance of ITRF and their time-variable relations. Any modification of the definition of the system is of the sole responsibility of IAU, so that the reference system (ICRS) is to remain untouched. However, individual positions of the sources must continue to be improved. This means that:

i) All primary sources must be regularly observed in a coordinated manner as well as their structure.

ii) Other ICRF sources must also be occasionally re-observed and the evolution of their structure systematically analyzed, so that a stock of potential primary sources be updated.

iii) The list of primary sources must be modified whenever they are found to become inadequate and new primary sources be added accordingly, without modifying the representation of the system.

iv) The number of sources of the ICRF must not stay stable. A densification of the catalogue with new sources is very desirable.

The role of IERS should be to initiate and coordinate observations, to decide on their frequency, to update the various lists of sources and decide on the time of such modifications to enter into force, according to the evolution of the requirements.

A small consultative group, appointed by IAU, should be set up, as an IERS subgroup, to recommend actions or procedures. It could be the successor of the present IAU WGRF.

2) Maintenance of references in optical spectrum.

The objective is to follow the accuracy with which the optical primary catalogue (now Hipparcos, later . . .) represents the ICRS,

to promote observations to maintain it and, if felt necessary, to increase the quality of the link.

At present, the most significant contributions are VLBI and MERLIN observations of Hipparcos radio stars with respect to ICRS radio sources. A coordinated observation program should be initiated. Contributions from ground-based optical astrometry should also be considered and, if alternate methods are available, they should similarly be coordinated.

In addition to the coordination of these programs, the role of IERS should be to analyze the results, and make a list of stars that are thought to be the best representatives of ICRS in optical wavelengths (some kind of primary stars for ICRS). It should promote observation programs and either organize them or stay in close contact with the people responsible for them (eg. in case of a new astrometric satellite).

IERS must be helped in this work by a group of specialists. We suggest that it is the same subgroup as the one defined in the first section.

3) Maintenance of other catalogues.

It is important that other catalogues represent also the ICRS and that there are no slippage with time. There should be a continuous check on the most used ones (PPM, TYCHO and new ones that will be constructed using Hipparcos and other new or old data).

It should however not be the role of IERS to provide the checks. It could do the comparisons between the catalogues, but the main task would be to centralize the results and give some kind of recognition to the links that would be considered as the most significant. At this level, the important parameters to be publicized are the accuracy and the biases of the link.

4) Reference frames based in other wavelengths and upon other objects

It would be useful to investigate the necessity of extending ICRS in the infra-red and microwave spectral domains. The subgroup defined in the first section should consider the analyses of catalogues of objects in other wavelengths (e.g., IRAS) and, if appropriate, establish ties between those catalogues and the ICRS.

In general, a catalogue (such as IRAS) is nominally based upon an existing reference catalogue (e.g., FK4), and would automatically be tied to the ICRS by the FK4-ICRS link, if such has been established. However, if the accuracy of the catalogue exceeds that of the one to which it is nominally referenced, then it would become necessary to establish its own link to the ICRS.

If the IERS does assume the coordinating role of the WGRF, as mentioned in the first section, it is to include into its consideration, possible reference frames used in astronomy based upon objects, such as the galactic coordinate system. In such a case, where there would naturally be other specialists involved, the IERS subgroup should serve only to encourage and promote the establishment of the appropriate frame-tie determined by

the specialists themselves.

5) Motions of the equinox and of the ecliptic.

The dynamical reference system, as realized by the ephemerides of the major bodies in the solar system, is no longer based upon the mean equator and mean dynamical equinox, nor upon the mean dynamical ecliptic. Instead, the most recent ephemerides are based directly upon the ICRF. However, the equinox and ecliptic do remain as important concepts in a number of applications, such as analytical derivations of precession and nutation, etc. Therefore, it is necessary to make an effort to know the relation between the ICRF and the best determinations of the equator and ecliptic.

The instantaneous positions and motions of the equinox and ecliptic are given by the planetary ephemerides. The determination of their means at a given epoch, however, requires some later analysis. Further, there are two different definitions of the ecliptic. Therefore, uncertainties in the final locations of the equinox and ecliptic arise from different ephemerides, different methods of analysis, and the differing definitions of the ecliptic itself. The IERS should monitor these differences, make available the different determinations, and present an estimation of the uncertainties of the results.

6) Millisecond pulsar timing.

Information from the timings of millisecond pulsars is useful for determining the earth's orbit and for orienting the whole inner planetary system onto the ICRF. These objects have now been observed, measured, and analysed for well over a decade by specialists outside of the IERS, and there is no reason to believe that this activity will not continue into the future. The IERS, however, can certainly encourage the observation of the millisecond pulsars in order to ensure their continued support.

In a lesser role, the IERS could assist in the collection and distribution of the analyses and results of those more actively involved in the studies of the millisecond pulsars.

7) IERS Standards

All the information present in the IERS Standards of interest to astronomy, including numerical standards, celestial reference frames, transformations between systems and Relativistic models should continue to be carefully followed and updated. The important point here is the availability to the astronomical community in a timely manner. Coordination with the IAU Working groups is necessary.

The IERS is to establish coordination with the IAUWGAS and SOFA (Standards Of Fundamental Astronomy). Certainly, the IERS must maintain its own set of standards as it has done in the past. However, when possible without sacrificing accuracy or efficiency, these standards should be chosen to conform with those of the IAU WGAS.